P38：液晶体系的三段剪切行为

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在剪切场下，液晶体系展现出特殊的流变学现象，比如剪切粘度的三段行为（随剪切速率增加：剪切变稀—剪切平台—剪切变稀）和负值的法向应力 [1]。这些现象与传统的高分子所表现出的剪切粘度的两段行为（随剪切速率增加：剪切平台—剪切变稀）和正法向应力截然不同 [2]。为了探寻液晶体系宏观流变现象下所蕴涵的微观机制，前人做了大量的实验和理论。Larson等人的理论比较好的预测了负值的法向应力，与实验相吻合 [3]。但是，对于剪切粘度的三段剪切行为，目前鲜有合理的解释。本文从微观动力学的角度来研究三段剪切行为。我们发现，随着剪切速率的增加，液晶体系的指向失表现出截然不同的四种运动形式（此处的研究对象为单畴，整个液晶体系用平均取向来代替，平均取向即指向失），P-A，K，W，F-A。而且研究表明，液晶体系的微观动力学确实与三段剪切行为有着密切的关联，目前更加深入的研究已经开展。

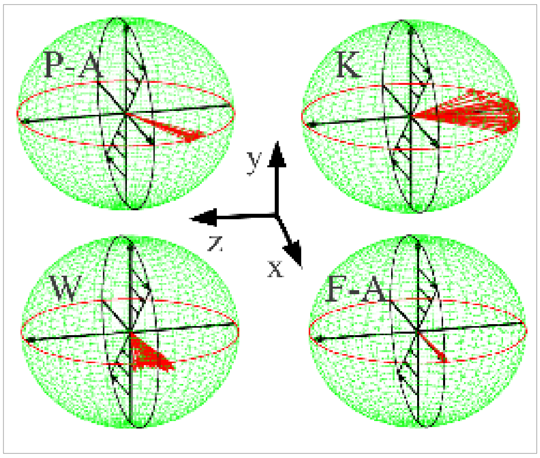

Fig. 1 With increasing shear rates, the director for a monodomain exhibits four different dynamics. This figure shows the time trajectories of the four different dynamics. x, y, z respectively indicates the flow, gradient, vorticity directions.

关键词：液晶；流场；动力学；三段剪切。

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The Three Region Behavior of Shear Viscosity for LCP

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The LCPs exhibit novel rheologies under shear flow, such as, three region flow curve of shear viscosity and negative first normall stress. Meanwhile, the classical flexible polymers never behave such novel rheologies. A number of theoretical and experimental works have been done to explore the microscopic mechanism underlying the macroscopic rheologies. The theoretical model by Larson successfully predict the negative normal stress, while the three region behavior is still lack of well understanding. This work investigates the microscopic dynamics of LCPs in a monodomain, where the dynamics can be characterized by a director. With increasing shear rates, four different types of dynamics are found, namely, P-A, K, W, F-A. The potential relation between dynamics and rheologies is discussed, and more efforts are needed in this aspect.